

Key

Name: _____ Period: _____ Date: _____
Honors Physics
Miss Brienza

Universal Gravitation Test Review

1. Data: Mass of Mars: 6.42×10^{23} kg
Mass of the Sun: 1.991×10^{30} kg
Mars's distance from the Sun: 2.279×10^{11} m

Answer each of the questions below about the planet Mars.

- a) Find the velocity with which Mars moves around the Sun.

$$V = \sqrt{G \frac{M}{d}} = \sqrt{\frac{6.67 \times 10^{-11} (1.991 \times 10^{30})}{2.279 \times 10^{11}}}$$

$$V = 24,139.39 \text{ m/s}$$

- b) How long in days does it take Mars to make one revolution about the Sun?

$$V = \frac{2\pi r}{T} \rightarrow T = \frac{2\pi r}{V} = \frac{2\pi(2.279 \times 10^{11})}{24,139.39}$$

$$T = 59319544.72 \text{ seconds} = 686.6 \text{ days}$$

- c) What is the Force of gravity experienced by ^{Mars}~~Mercury~~ from the Sun?

$$F_g = G \frac{m_1 m_2}{d^2} = 6.67 \times 10^{-11} \frac{(6.42 \times 10^{23})(1.991 \times 10^{30})}{(2.279 \times 10^{11})^2}$$

$$F_g = 1.642 \times 10^{21} \text{ N}$$

2. A spacecraft is 15,800 km above the Earth's surface. It's mass is 2000kg. The mass of the earth is 5.97×10^{24} kg. The radius of the earth is 6.38×10^6 m.

a. What is the force of gravity?

$$* d = r + a \quad F_g = G \frac{m_1 m_2}{d^2} = 6.67 \times 10^{-11} \frac{(2000)(5.97 \times 10^{24})}{[6.38 \times 10^6 + 15,800,000]^2}$$

$$F_g = 1618.85 \text{ N}$$

b. What is the centripetal acceleration?

$$F = ma$$

$$1618.85 = 2000a \rightarrow a = .809 \text{ m/s}^2$$

c. What is the tangential speed?

$$a = \frac{v^2}{r}$$

$$.809 = \frac{v^2}{(6.38 \times 10^6 + 15,800,000)} \rightarrow v = 4237.1 \text{ m/s}$$

3. Find the altitude of the orbit of a geosynchronous satellite that circles the earth. (Note that R is measured from the center of the earth, not the surface and the altitude is measured from the surface.) The mass of the earth is 5.98×10^{24} kg. The radius of the earth is 6.38×10^6 m.

$$T = 86,400 \text{ sec}$$

$$v = \frac{2\pi r}{T} = \sqrt{G \frac{M_e}{r}}$$

$$\frac{4\pi^2 r^3}{T^2} = G \frac{M_e}{r}$$

$$r^3 = \frac{G M_e T^2}{4\pi^2}$$

$$r^3 = \frac{6.67 \times 10^{-11} (5.98 \times 10^{24}) (86400)^2}{4\pi^2}$$

$$r = 42250474.31 \text{ m} \leftarrow \text{total distance need to subtract } r_e$$

$$42250474.31 - 6.38 \times 10^6$$

$$a = 35870474.31 \text{ m}$$